

U-07

Picosecond X-ray Science

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The Short Pulse X-ray (SPX) facility will extend time-resolved x-ray scattering and spectroscopy to the picosecond timescale while retaining the powerful characteristics of synchrotron radiation, i.e., user-controlled continuous tunability of energy, polarization, and bandwidth combined with exquisite x-ray energy and pulse length stability over a wide energy range. Experiments at the SPX facility will produce one-picosecond stroboscopic snapshots of molecular rotations, molecular excited-state transient structures, stress/strain wave propagation, magnetic domain wall dynamics, phase transitions, and the coupling between electronic, vibrational, and magnetic degrees of freedom in condensed matter systems. Time-resolved studies of transient dynamics will be possible with simultaneous picosecond time resolution and picometer structural precision for a variety of atomic, molecular, supramolecular, nanoscale, and bulk material systems. Transformational developments are now taking place in high-average-power pulsed laser technology, with substantially increased repetition rates that promise to make highly efficient use of the MHz x-ray repetition rates of the SPX. We propose to develop, in the context of the APS Upgrade, five end stations with scattering, diffraction, spectroscopy, imaging, and microscopy capabilities.